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Neural Network-based Resolutions for Pion Energy Calibration with the ATLAS Detector

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Calibrating the pion energy response is a core component of reconstruction in the ATLAS calorimeter. Deep learning techniques have shown the best energy resolution for a wide range of particle momenta [1]; to further improve the pion energy resolution, a Mixture Density Network (MDN) based deep learning algorithm is explored. In addition to estimating the energy, the MDN also estimates the associated energy resolution for each individual pion; this enables the resolution to be quantified on a per pion basis for the first time. This work demonstrates the potential of MDN-based low-level hadronic calibrations to significantly improve the quality of particle reconstruction in the ATLAS calorimeter. This work is done in the context of the ML4Pions group in the ATLAS Collaboration.

[1] ATLAS Collaboration, Deep Learning for Pion Identification and Energy Calibration with the ATLAS Detector, ATL-PHYS-PUB-2020-018, 2020

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